PENN STATE WILKES-BARRE
Electrical Engineering Technology Program
P.O. Box PSU
Lehman, PA 18627

PROPOSAL FOR AN ECETDHA MINI-GRANT

PROJECT TITLE**:** Taking Engineering Technology to new heights: Developing and Testing of Communication Systems for High Altitude Balloon activities

PROJECT DIRECTOR:
Albert Lozano-Nieto, PhD
Professor of Engineering
AXL17@psu.edu
570-675-9245

ABSTRACT: This proposal has two interrelated goals. The first goal is to improve the High Altitude Balloon program for Engineering Technology students that I am currently running at Penn State Wilkes-Barre. The second goal is to use the same activities as an outreach tool in order to increase the interest of secondary students in Engineering and Engineering Technology. With these goals in mind, this proposal requests $600 from the ECETDHA.

JUSTIFICATION:

High Altitude Balloons are unmanned balloons filled with helium that once released reach altitudes of up to 90,000 feet or even higher. As the balloon increases its size with the lower atmospheric density at high altitudes, it reaches a point at which it bursts. The balloon then falls back to Earth using a parachute to decrease its terminal speed. The balloon contains one or more payloads with electronic instrumentation such as GPS, real-time transmission, telemetry, video cameras as well as science and experimental modules. The GPS and electronic transmission devices are used by the recovery team to track the location of the balloon and predict its landing site. The data acquired by the payloads is as diverse as the imagination of those involved in its design. Typical parameters to measure include temperature, air pressure, flight path, altitude, and any other parameters that students decide to measure.

There is an increasing history of several universities establishing this type of programs to support retention of students in STEM disciplines as well as increase the interest of secondary students into STEM programs. One of the most enticing things about High Altitude Balloon launches is the standard challenge of solving new problems when they arise. It is in this environment that

students learn to readily solve challenging problems without intimidation. Students learn not only the specifics of the subject matter in their intended majors such as electrical loads, voltages, mechanical aspects, etc., but more importantly, they acquire professional skills. In order to have a successful flight, students must apply basic principles of project management, finish their different experiments on time, work effectively in groups, communicate effectively with others, etc.

Because each High Altitude Balloon can carry several payloads, it is then possible to reserve a number of these payloads for science experiments carried out by secondary school students. These students and their teachers can be, for example, invited to build one or more experiments, witness the launch, and analyze the data gathered by the balloon in real time as it ascends through the atmosphere as well as plot its location also in real time. These activities will give secondary students an early appreciation of the diverse type of educational programs in engineering technology, contributing to reverse the trend of declining enrollments in this area of study.

SPECIFIC SUPPORT FROM ET-MINI GRANTS

The specific support requested in this ET-Mini Grant proposal is to seek fund to partially fund the development by the students of analog and digital communication modules between the balloon and the ground.

Students enrolled in the BS degree in Electrical Engineering Technology at Penn State Wilkes-Barre will have to design, build, test and verify these modules before an actual flight. Students will have to analyze the constrains of the design, for example a communications range at the highest point of 20 miles (albeit unobstructed) between balloon and ground, the need not to interfere with the main communications system, limitations in weight, power, etc… Students also have to develop meaningful test procedures before the flight and evaluate the potential problems that may arise. In summary, students experience the full design cycle culminating on its real-life application.

INTENDED REPORT and DISSEMINATION:

I am scheduled to present a talk at the 2011 CIEC Conference this coming February describing the experiences with High Altitude Balloons at Penn State Wilkes-Barre. Once this proposal is funded and we are able to carry out student experiences on digital communications, I will write a paper on these particular experiences and will submit it to one of the journals read by the Engineering Technology community. I also want to highlight and evaluate the student learning that takes place during the pre-flight, flight and post-flight discussions.

Ultimately, after I gain more experience on these flights, I would like to present a workshop on High Altitude Balloon programs for Engineering Technology at the Summer ASEE conference.

This conference typically reserves one day before its official start to specific workshops of interest to the attendees. I believe that due to its relatively low cost, the Engineering Technology community will find High Altitude Balloon activities a very exciting tool to motivate our students. I believe that I can have enough experience to give this workshop at the 2012 ASEE Conference.

BUDGET FOR PROJECT

Digital and Analog Communication modules	$ 350
Other General Hardware components	$ 100
Costs of Printed Circuit Boards, assembly, etc	$ 150
Total Requested from ET-Minigrant:	**$ 600**

Note that the costs associated to launch and recovery (latex balloon, helium, gas for the recovery vehicles and other consumables) are not considered in this proposal. Neither are considered the fixed costs such as the main communication systems, antennas, etc. that I already have.